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BULLETIN
OF THE
TORREY BOTANICAL CLUB.

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The Development of the Antheridium in Ferns.

By Douglas H. Campbell.

Plate LIV.

In a paper read before the last meeting of the American Association for the Advancement of Science, I called attention to the readiness with which the prothallia of ferns may be grown, and their value as types in the study of development. In the present paper I have endeavored to give a few hints in regard to the study of the antheridium, suggested by a somewhat extended study of a number of species.

In selecting species for study, it is best to choose those that are diœcious, or else to study the young prothallia of the monœcious species; as in the larger monœcious prothallia, longitudinal sections are necessary, while in the small male prothallia of such diœcious forms as *Asplenium filix-fœmina*, for instance, they may be studied by placing the whole prothallium upon the slide.

The observations here recorded were made principally upon the latter species and the two species of *Onoclea*, *O. Struthiopteris* and *O. sensibilis*, all of which are almost absolutely diœcious, and do not differ in any essential particulars in the formation of the antheridium.

The best results are obtained by growing the prothallia artificially, as it is very rare to find them growing naturally, and it is a very simple matter to grow them. The spores germinate in from three days to a week from the time they are sown, and are ready for study in about six weeks time, when under favorable circumstances abundance of ripe antheridia may be observed. The best results were obtained by sowing the spores in fine earth and keeping moist, and somewhat shaded, a bell-jar being used to prevent too rapid evaporation. Care must be taken.

however, not to keep the ground soaking wet, or else there is danger of the prothallia rotting.

The young male prothallia are small, and often of irregular form (Fig. 1), the antheridia (*an.*) arising from the marginal, or sometimes the terminal cells. They arise as papillae, resembling very much at this stage, the young root hairs, but soon become distinguished by their denser contents, and more regularly hemispherical form (Fig. 2, *an.*)

The young antheridium now becomes cut off from the cell of the prothallium by a wall, and is seen to contain a distinct central nucleus, around which the contents are more granular than in the peripheral portions of the cell. Among the granules are some chlorophyll bodies, but these are smaller than those of the other cells of the prothallium.

The first wall formed within the antheridium is funnel-shaped in most cases, the broad portion being directed upward, and the point in contact with the wall by which the antheridium was cut off from the cell of the prothallium (Fig. 3, *a-n*). Sometimes before this is differentiated a wall is formed parallel to the latter, thus making a pedicel, but this was quite exceptional. In some cases the point of the funnel-shaped wall does not reach to the base of the antheridium, or the wall may even be nearly flat.

The second wall (Fig. 3, *b*) is much less variable, being approximately hemispherical, and parallel to the outer wall of the antheridium.

Finally a third wall is formed, resembling the first one in form, and cutting off the covering cell of the antheridium (Figs. 4, 8.)

The antheridium now consists of four cells, three parietal and a central cell. The two lower parietal cells are annular in form, the upper one flat. They all are nucleated and contain a number of small chlorophyll granules. The central cell appears pentagonal when seen from the side, and is characterized by a large nucleus and dense, granular and highly refractive protoplasm.

The division of the central cell begins either before, or immediately after the formation of the covering cell. The first wall (Figs. 3, 8) is nearly vertical, and is soon followed by a second vertical one at right angles, so that when the antheridium is seen from above the central cell appears divided into four, arranged like the quadrants of a circle. These are followed by others until the full number, varying a good deal, even in the same species, is formed.

The central cell now consists of a tissue composed of small, thin-walled polyhedral cells, each one having a small but distinct nucleus. The antherozoids are derived directly from the nucleus, which, previous to their formation, becomes indistinct, but does not actually disappear. As soon as it can be definitely observed again, it is seen to have increased in size and to have become curved (Fig. 9.) It rapidly increases in size, becoming at the same time more curved, until it finally comes to occupy nearly the whole cell, some granular protoplasm, however, remaining between the coils, especially toward the centre of the cell. When the antherozoids are fully grown, the sperm-cells have increased in size so as to crowd upon the parietal cells, and occupy nearly the whole space of the antheridium, which is now nearly globular. (Fig. 5.)

The walls between the sperm-cells now undergo a change, becoming mucilaginous, so that when water is applied they dissolve, allowing the antherozoids to become separated, but enough of the wall remains, so that they are still enclosed in a delicate membrane. The dissolution of the division walls is accompanied by very evident movements of the contents of the antheridium.

When the antherozoids are ready to escape, the parietal cells absorb water with great avidity, until the pressure becomes so great as to rupture the wall of the antheridium. This usually occurs between the middle and top cell, the latter being torn open ; or sometimes simply through a fissure in the cap-cell. As the parietal cells absorb the water they become very much distended, pressing in on the mass of sperm-cells, which are thus forced out through the opening. In cases where the first wall in the antheridium did not extend to the base, it was forced up by the absorption of water in the cell beneath, so as to nearly obliterate the cavity of the antheridium.

The antherozoids remain for a few moments after their escape enclosed in the remains of the wall of the mother-cell, but this is soon ruptured and the antherozoid swims rapidly away, dragging after it the remains of the contents of the mother-cell as a very delicate vesicle (Fig. 7, *v.*)

The body of the antherozoid is coiled, the coils toward the posterior end being larger. It is generally somewhat flattened at the anterior end, where there are numerous cilia, and more or less pointed at the other, which may be drawn out into a long, delicate filament.

After the escape of the antherozoids the inner walls of the antheridium (Fig. 6) soon assume a dark brown color.

In the preparation of specimens for study, very little use was made of reagents, most of the work being done with living specimens mounted simply in water.

EXPLANATION OF FIGURES.

Fig 1. Small male prothallium of *Asplenium filix-fœmina*; × 150. *An*, antheridia; *r*, root hair.

Figs. 2-5. Successive stages in the development of the antheridium of the same; × 500. All except Fig. 4 in optical longitudinal section.

Fig. 6. An empty antheridium of the same; × 550.

Fig. 7. Antherozoids of the same; *a*, before, *b*, after escaping from the mother-cells, × 625; *v*, vescicle:—remains of the central contents of the mother-cell.

Fig. 8. Young antheridium of *Onoclea sensibilis.* Optical section from the side; × 500.

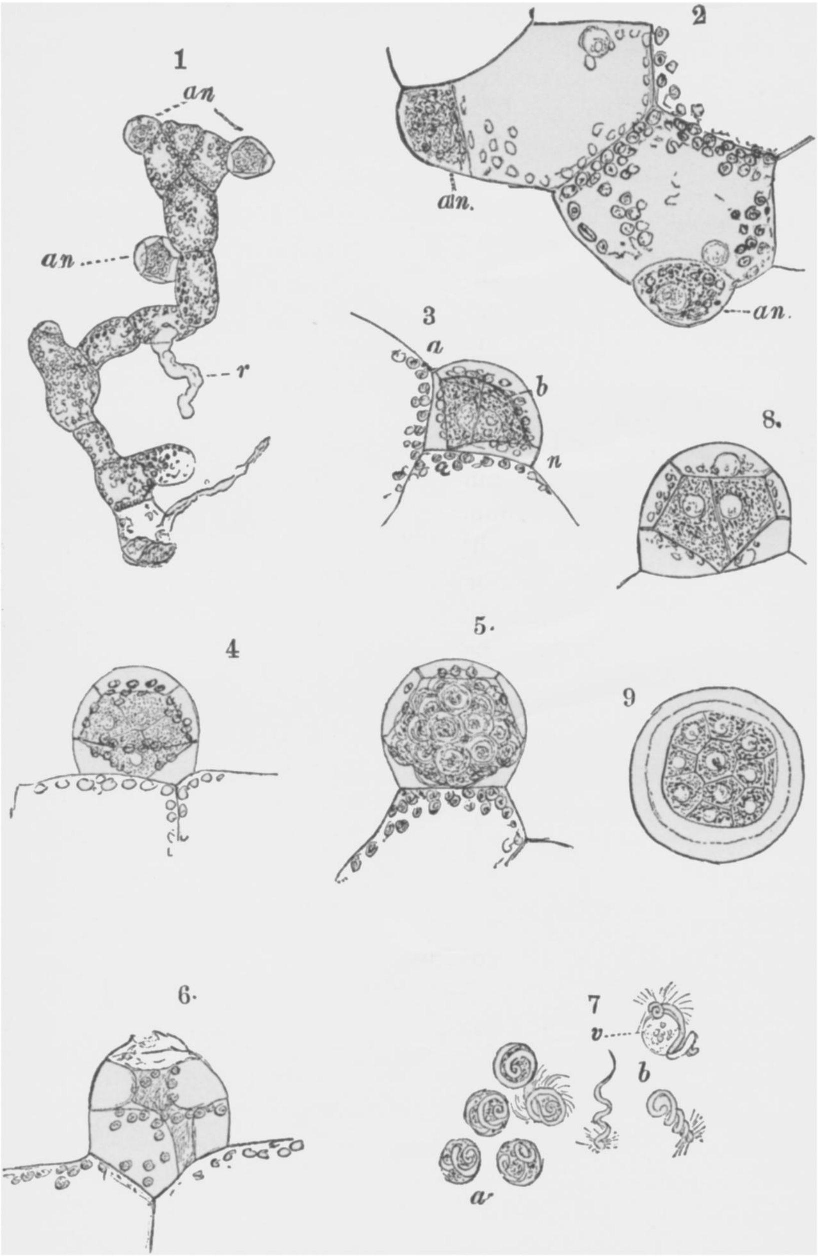
Fig. 9. An older one of the same species from above; × 500.

New American Grasses.

BY GEORGE VASEY.

ARISTIDA REVERCHONII, Vasey.—Culms slender, 1 to 2 feet high, unbranched, smooth; radical leaves 3 to 6 inches long, involute filiform, straight or curved; culm leaves about 3, rigid, erect, filiform and involute, 3 to 6 inches long; ligule a ciliate line; sheaths smooth, close, shorter than the internodes; panicle erect, spike-like, slender, 4 to 6 inches long; the branches appressed and sessile, single and alternate, the lower ones 1 to 1½ inches long, all closely flowered, and longer than the internodes;

Bulletin of the Torrey Botanical Club. Plate LIV.



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